

The Department of Defense Should Avoid a Joint Acquisition Approach to the Sixth-Generation Fighter

History suggests that when the Department of Defense (DoD) considers sixth-generation fighter aircraft capabilities, some will argue that a single joint acquisition program would cost less than multiple service-specific programs. Joint aircraft programs, in which two or more services participate in the development, procurement, and sustainment of a single baseline design, are thought to save life-cycle costs by eliminating duplicate research, development, test, and evaluation (RDT&E) efforts and by achieving economies of scale in procurement and operations and support (O&S).¹ Yet, the need to accommodate different service requirements in a single design or common design family can lead to greater program complexity, increased technical risk, and common functionality and weight in excess of what is needed by an individual service. These factors can increase the overall cost, despite the efficiencies gained from a joint approach.

RAND Project AIR FORCE (PAF) research shows that historical joint aircraft programs have not saved money, have caused services to accept unwelcome design compromises, have contributed to the shrinking of the industrial base, and have increased strategic and operational risk. Consequently, unless the participating services have identical, stable requirements, DoD should avoid taking a joint approach to acquiring future fighter and other complex aircraft.

Historical Joint Aircraft Programs Have Not Saved Overall Life-Cycle Costs

Although it is typical for major acquisition programs to experience some cost growth in the RDT&E and procurement phases, cost growth for joint aircraft programs, on average, has been more severe than for single-service programs. PAF compared the acquisition cost estimates (which include both RDT&E and procurement) for the four most recent historical joint aircraft programs (the JSF, the T-6A Joint Primary Aircraft Training System, the E-8 Joint Surveillance Target Attack Radar System, and the V-22 Osprey) and the four most recent historical single-service programs (the C-17

¹ *Acquisition cost* includes RDT&E and procurement (series production). *Life-cycle cost* includes acquisition costs plus O&S cost associated with operating, maintaining, and supporting a system over the anticipated lifetime of the aircraft, typically about three decades or more.

Key findings:

- Joint aircraft programs have not historically saved overall life-cycle cost.
- The difficulty of reconciling diverse service requirements in a common design or design family is a major factor in historical joint aircraft cost outcomes.
- The JSF is exhibiting trends similar to prior joint aircraft programs.
- Historical analysis suggests that joint aircraft programs have coincided with contraction in the industrial base and thus a decline in potential future industry competition and increased strategic and operational risk.
- Unless the participating services have identical, stable requirements, DoD should avoid future joint fighter and other complex joint aircraft programs.

airliner, the F/A-18E/F fighter, the F-22 fighter, and the T-45 trainer).² At nine years past Milestone B,³ acquisition cost estimates grew by an average of 24 percent for single-service programs and 65 percent for joint programs. Thus, at nine years past Milestone B, historical programs show a “joint acquisition premium” of an additional 41 percent cost growth, on average.⁴

Joint programs cannot save enough money in the RDT&E, procurement, and O&S phases to offset the joint acquisition cost-growth premium. In theory, assuming a hypothetical ideal joint program in which two services acquire equal numbers of identical fighters, the maximum

² This selection represents all the major U.S. military aircraft acquisition programs undertaken since the mid-1980s, with the exception of highly classified “black” programs, for which the appropriate cost data are not available.

³ Milestone B marks the point at which a defense acquisition program has permission to move into the engineering and manufacturing development phase.

⁴ PAF analysis shows that the average joint acquisition cost-growth premium varied between a low of 30 percent to a high of 44 percent between five years and nine years past Milestone B. Data were not available for all eight programs beyond nine years past Milestone B.

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savings in acquisition costs before cost growth would be 20 percent.⁵ However, the average joint acquisition cost-growth premium seen in historical programs within nine years past Milestone B would negate these savings. Given these factors, a typical joint fighter program would need to realize over 10 percent savings in O&S costs to bring the total life-cycle cost below that of two single-service programs.⁶ PAF analysis of historical O&S cost data from existing fighter programs suggests that an ideal joint fighter program involving two services procuring identical aircraft and with 100 percent sharing of all support assets and infrastructure could save a maximum of about 3 percent as a result of economies of scale.⁷

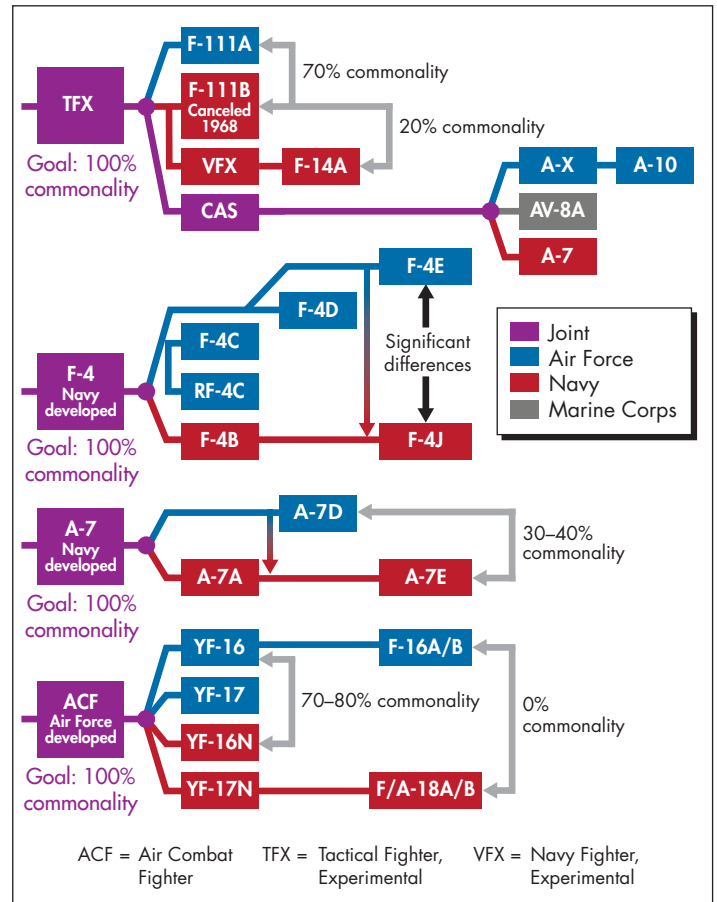
We conclude that although joint aircraft programs do, in theory, save money, the savings are too small to offset the substantial additional average cost growth historically seen in the acquisition phase. Historical joint aircraft programs have not yielded overall life-cycle cost savings compared with single-service programs.

The Need to Accommodate Service-Unique Requirements Contributes to the Joint Cost-Growth Premium

A major factor contributing to the joint cost-growth premium is the inherent tension between system commonality—the primary source of joint savings—and service-specific requirements. Historically, services have entered joint aircraft programs with unique requirements resulting from different operating environments, missions, doctrine, and operational concepts. Attempts to accommodate these requirements within a common airframe can increase technical complexity and risk, thus prolonging RDT&E and driving up acquisition costs. The attempt to incorporate differing requirements in the same basic design also leads to excess functionality and weight, which, in turn, increases cost and risk.

The figure illustrates the tensions between commonality and service optimization in four historical joint fighter programs from the 1960s and 1970s, each of which began with the goal of 100 percent commonality. In every case, these joint programs evolved into service-specific variants with decreasing commonality. In some cases, such as the ACF, the program gave rise to distinct platforms with little or no commonality. In other cases, necessary design compromises left the services unsatisfied, even resulting in one or more partners withdrawing from the program (as in the Air Force/

Commonality vs Service Optimization in Historical Joint Fighter Programs



Navy F-111). These factors negate the cost benefits associated with system commonality and increase the joint cost-growth premium.

The Joint Strike Fighter Is Exhibiting Trends Similar to Prior Joint Aircraft Programs

The largest and most recent joint aircraft program is the JSF, which was designed for use by the U.S. Air Force, U.S. Navy, U.S. Marine Corps, and international partners and is currently in production. Early in the program, JSF planners took steps to mitigate many of the challenges experienced by prior joint aircraft programs. PAF assessed whether the JSF appears to be on track to cost less over its life cycle than if the services had pursued three separate fighter programs.

We examined life-cycle cost estimates for the JSF over a period of nine years, starting with Milestone B.⁸ We then developed representative cost estimates for three notional single-service fighter programs over a similar period. We made conservative assumptions that generally favored the joint program approach:

⁵ This assumes a typical fighter production cost improvement curve of 87 percent. It also assumes a representative modern fighter aircraft program, in which procurement spending is four times that of RDT&E.

⁶ This assumes that O&S costs make up the same fraction of life-cycle cost as in the JSF program as estimated at Milestone B.

⁷ A hypothetical ideal three-service joint program could save a maximum of 4.7 percent in O&S costs.

⁸ At the time we collected data on the JSF, only nine years of data past Milestone B were available.

- We assumed that RDT&E for single-service programs is 67 percent higher than for the JSF (per the JSF program office estimate).⁹
- We assumed that single-service programs procure the same number and identical type of aircraft as their corresponding JSF variants but do not benefit from any common learning or cost improvement.
- We assumed that the notional single-service fighter had zero commonality among the three fighters, including airframe, engines, avionics, and subcomponents.
- We assumed that single-service programs conduct completely separate O&S and therefore do not enjoy economies of scale in O&S.
- We assumed that RDT&E and procurement cost-growth rates for the single-service programs are the same as for the F-22 (at nine years past Milestone B), a heavier, more complex, higher-risk fighter than the JSF.
- We assumed that O&S cost growth rates are the same as for the F-22 (at 9.7 years or 14 years past Milestone B).¹⁰

From an *acquisition cost* perspective, the JSF's original Milestone B estimate is 25 percent lower than the estimate for three notional single-service fighters. However, nine years past Milestone B, the JSF's acquisition costs are 10 percent higher than for notional single-service programs. This is consistent with historical experience, which shows that higher acquisition cost growth can cancel out the cost advantages expected at Milestone B. Increased technical and programmatic complexity and decreasing commonality between variants are key drivers of the JSF's acquisition cost growth.

From a *life-cycle cost* perspective, the JSF's original (Milestone B) estimate is 16 percent lower than the estimate for three notional single-service fighters, again reflecting the theoretical advantages of a joint program. However, the O&S cost estimate for the JSF grew substantially in the nine years following Milestone B. At that point, we estimate the JSF's total life-cycle cost to be 65 percent higher than for the notional single-service fighters. Even if we assume that the single-service fighters experience a higher rate of cost growth (such as in the F-22 program at 14 years past Milestone B), the JSF's life-cycle cost is estimated to be 37 percent higher. We did not assess why the JSF O&S cost estimate has experienced such high cost growth.

The analysis suggests that the JSF is progressing similarly to legacy joint aircraft and is not expected to save money over separate single-service programs. Moreover, single-service programs could have optimized different designs that better meet the needs of each service. *While this analysis does not provide a policy prescription for the current JSF program*—which is far along its development path—it underscores the skepticism with which decisionmakers should approach cost-savings arguments for future complex joint aircraft programs.

Joint Aircraft Programs Have Additional Effects

Looking beyond cost considerations, policymakers should be mindful of the effects of joint aircraft programs on the combat aircraft industrial base and on operational risk. The pursuit of joint aircraft programs in recent decades has coincided with a reduction in the number of major fighter aircraft prime contractors from eight in 1985 to only three today. Lockheed Martin is the only prime contractor actively leading a fifth-generation manned fighter-attack aircraft development and production program (the JSF). Such a situation reduces the potential for future competition, may discourage innovation, and makes costs more difficult to control. Whether the next fighter development program is joint or single-service, acquisition decisionmakers will face the challenge of a more concentrated and possible smaller industrial base and must understand the effect of acquisition strategy on the long-term health of the industry.

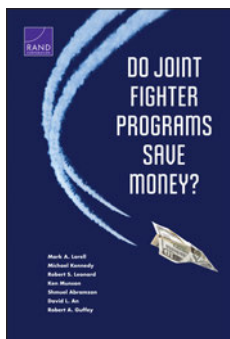
In addition, having a variety of fighter platform types across service inventories provides a hedge against design flaws and maintenance and safety issues that could potentially cause fleet-wide stand-downs. Having a variety of fighter platform types also increases the options available to meet unanticipated enemy capabilities. The more the U.S. military employs joint fighters, the fewer the options that will be available to meet these unforeseen challenges.

Recommendation

Informed by this analysis, PAF recommends that, unless the participating services have identical, stable requirements, DoD should avoid future joint fighter and other complex joint aircraft programs.

⁹ The JSF program office estimates that the JSF would be able to carry out the RDT&E of three different fighter variants for 60 percent of the cost of three single-service programs combined.

¹⁰ F-22 reached Milestone C at 9.7 years past Milestone B and initial operational capability at 14 years past Milestone B. O&S cost estimates increased during this period.



This research brief describes work done for RAND Project AIR FORCE documented in *Do Joint Fighter Programs Save Money?* by Mark A. Lorell, Michael Kennedy, Robert S. Leonard, Ken Munson, Shmuel Abramzon, David L. An, and Robert A. Guffey, MG-1225-AF, 2013 (available at <http://www.rand.org/pubs/monographs/MG1225.html>); and *Do Joint Fighter Programs Save Money? Technical Appendixes on Methodology*, by Mark A. Lorell, Michael Kennedy, Robert S. Leonard, Ken Munson, Shmuel Abramzon, David L. An, and Robert A. Guffey, MG1225/1-AF, 2013 (available at <http://www.rand.org/pubs/monographs/MG1225z1.html>). The RAND Corporation is a nonprofit research institution that helps improve policy and decisionmaking through research and analysis. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors. **RAND®** is a registered trademark.

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